

Total Synthesis of the Sesquiterpenoid Ishwarane: Structure of Ishwarone

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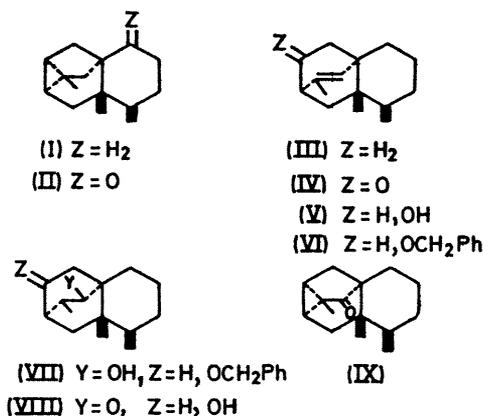
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Summary A total synthesis of ishwarane has been completed, thus providing proof of the correctness of the structure assigned to ishwarane and corroboration of the structure assigned to ishwarone.

cyclization, in 71% yield, to the cyclopropyl ketone (IX) as an oil, λ_{\max} (EtOH) 208 nm (ϵ 4000); i.r. (film) 1715 cm^{-1} ; n.m.r. (CDCl_3) δ ca. 0.5 (m, 2H). Finally, Wolff-Kishner reduction of (IX) afforded racemic ishwarane (I)

THE novel, biogenetically significant structures (I)¹ and (II)²⁻⁴ were recently suggested for the sesquiterpenoids ishwarane and ishwarone, respectively, and their structural relationship was demonstrated by reduction of ishwarone to ishwarane.¹ More recently⁵ we provided corroboration for these suggestions¹⁻⁴ by a total synthesis of isoishwarane (III),^{2,4} a conversion product of ishwarone. We have now completed a total synthesis of ishwarane (I), thus providing proof of the correctness of structure (I) for ishwarane and further corroboration of structure (II) for ishwarone.

We have previously reported⁵ the total synthesis of (IV) and we now describe its conversion into ishwarane (I). The enone (IV), on reduction with LiAlH_4 , gave two epimeric alcohols (V) (m.p. 116° and 110°, 40% of each). One epimer (V) [m.p. 116°; i.r. (Nujol) 3300 cm^{-1} ; n.m.r. (CDCl_3) δ 3.87 (br m, 1H), 5.63 (m, 1H)] was converted into the benzyl ether (VI) and then, by hydroboration in 82% yield, into a single alcohol (VII), m.p. 104°; i.r. (Nujol) 3465 cm^{-1} ; n.m.r. (CDCl_3) δ 3.60 (br m, 1H), 3.88 (d, 1H), 4.46 (s, 2H), 7.27 (m, 5H). Oxidation of (VII) with Jones' reagent followed by hydrogenolysis of the benzyl ether afforded 75% of the keto-alcohol (VIII), m.p. 91°; i.r. (Nujol) 3410 and 1705 cm^{-1} ; n.m.r. (CDCl_3) δ 4.05 (m, 1H). Treatment of the tosylate of (VIII) with methylphenyl carbanion⁶ in Me_2SO at 60° for 2 h resulted in



(60%) which was identical (i.r. and n.m.r. spectra and behaviour on t.l.c. chromatograms) with an authentic sample of ishwarane obtained from natural sources.

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² A. K. Ganguly, K. W. Gopinath, T. R. Govindachari, K. Nagarajan, B. R. Pai, and P. C. Parthasarathy, *Tetrahedron Letters*, 1969, 133.

³ T. R. Govindachari, K. Nagarajan, and P. C. Parthasarathy, *Chem. Comm.*, 1969, 823.

⁴ F. Fuhrer, A. K. Ganguly, K. W. Gopinath, T. R. Govindachari, K. Nagarajan, B. R. Pai, and P. C. Parthasarathy, *Tetrahedron*, 1970, **26**, 2371.

⁵ R. B. Kelly and J. Zamecnik, *Chem. Comm.*, 1970, 1102.

⁶ E. J. Corey and M. Chaykovsky, *J. Amer. Chem. Soc.*, 1965, **87**, 1345.